OCULAR CHANGES IN MONGOLISM

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There is no one sign that is diagnostic or pathognomonic of Down's syndrome; however, as a well-known popular song expresses it—"little things mean a lot." The ocular signs in Down's syndrome are among the most important, constituting at least a fifth of Øster's [1] ten cardinal signs.

The diagnosis of Down's syndrome is made through a constellation of clinical features. Since a large portion of the major diagnostic signs in this syndrome are localized to the face and hands, the ophthalmologist rarely has difficulty in establishing the diagnosis. Of paramount importance to this specialist are the ocular manifestations of the syndrome, among which the following shall be discussed: (1) congenital and acquired cataract; (2) keratoconus and corneal opacities; (3) iris stroma and color aberrations; (4) errors of refraction; (5) muscle imbalance; (6) configuration changes of the eyelids and palpebral fissure; (7) ocular infections; (8) radiological anomalies of the orbit, and (9) miscellaneous findings.

Before undertaking a discussion of the above, it must be emphasized that no matter how meticulous an examiner may be, one sees that of which he is aware and prepared by training to anticipate. Varying incidences of the numerous signs thus may be dependent as much on the examiner as well as reflecting individual variation in the affected patients. The majority of individuals studying ocular manifestations have limited their scope to ascertaining the incidence of certain specific traits.

It must be emphasized that all of the ocular changes found in Down's syndrome may also be found in lower incidence in the eyes of the normal population, many of which are gene-influenced.

Congenital and Acquired Cataract

Most authorities [2, 3, 9] recognize that there are four chief varieties of lenticular opacities (cataract) observable in better than 50% of the cases of Down's syndrome. Personal experience would suggest that this incidence is much higher if the patient is studied in his or her late teens and the examination is performed with a biomicroscope (slit lamp) with dilated pupils. In general, cataractous change in the crystalline lens of a mongoloid child is usually not observed before the age of seven to eight years. Congenital cataract may occur in Down's syndrome (3–11%) [4] but, as in a normal child, presents many varieties and may well represent purely coincidental random occurrence. On the other hand, cataract becomes almost ubiquitous with advancing age of the affected patient.

In the author's experience, two types of cataractous changes are most suggestive of Down's syndrome: (1) arcuate or curvilinear opacities which arc (FIGURES 1 and 2) about the fetal, or even the early juvenile nucleus, and (2)

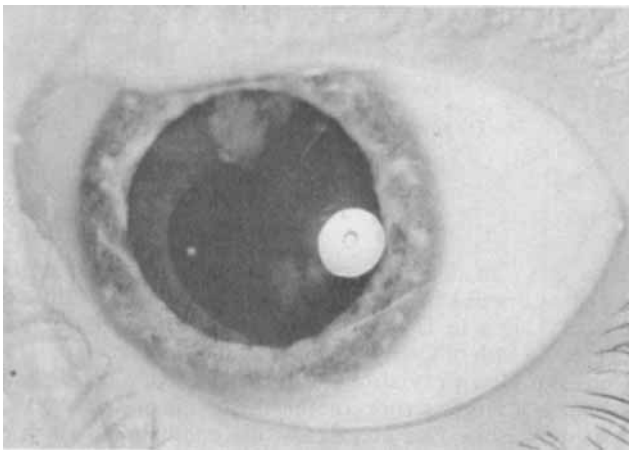

FIGURE 1

crystalline polychromatic opacities with or without sutural opacities. In addition—as in normal individuals (25%)—coronal opacities may be seen. Highly suggestive of Down's syndrome is the combination of dense arcuate and polychromatic crystalloid deposits in the more recent cortex of the lens that leaves a clear or free zone immediately beneath the capsule. Myotonic dystrophy may present almost identical lens changes with a paucity of the arcuate opacities.

As was mentioned previously, the literature [2-4] emphasizes that four types of (FIGURES 3–5) cataractous changes may be found in mongolism, including: (1) arcuate opacities which arc about the fetal nucleus; quite variable in extent, size and opaqueness; some appear thin and narrow, others are dense, very opaque, and may occupy a large sector of the lens; (2) sutural opacities—gray deposits in and about the sutures of the lens. In Down's syndrome they involve chiefly the anterior Y or, if later in onset, form more complex lens suture patterns. (3) As in normal individuals, congenital lens opacities are noted that

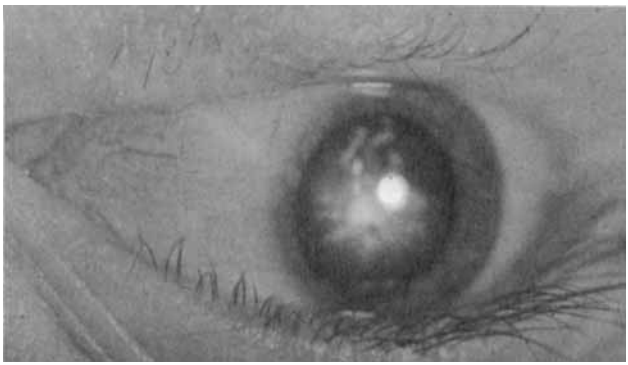

FIGURE 2

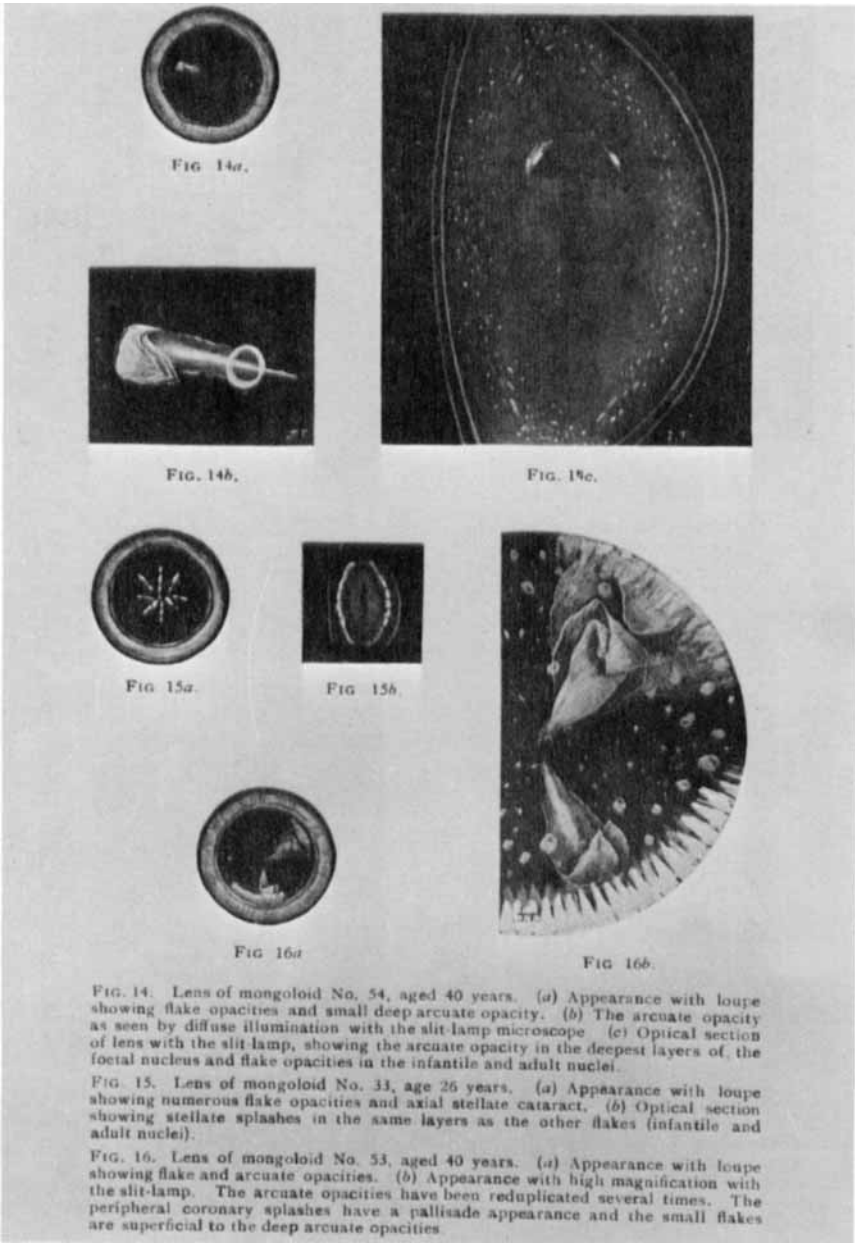

FIG. 14a.

FIG. 14b.

FIG. 14c.

FIG. 15a.

FIG. 15b.

FIG. 16a

FIG. 16b.

FIG. 14. Lens of mongoloid No. 54, aged 40 years. (*a*) Appearance with loupe showing flake opacities and small deep arcuate opacity. (*b*) The arcuate opacity as seen by diffuse illumination with the slit-lamp microscope. (*c*) Optical section of lens with the slit-lamp, showing the arcuate opacity in the deepest layers of the foetal nucleus and flake opacities in the infantile and adult nuclei.

FIG. 15. Lens of mongoloid No. 33, age 26 years. (*a*) Appearance with loupe showing numerous flake opacities and axial stellate cataract. (*b*) Optical section showing stellate splashes in the same layers as the other flakes (infantile and adult nuclei).

FIG. 16. Lens of mongoloid No. 53, aged 40 years. (*a*) Appearance with loupe showing flake and arcuate opacities. (*b*) Appearance with high magnification with the slit-lamp. The arcuate opacities have been reduplicated several times. The peripheral coronary splashes have a pallisade appearance and the small flakes are superficial to the deep arcuate opacities.

FIGURE 3

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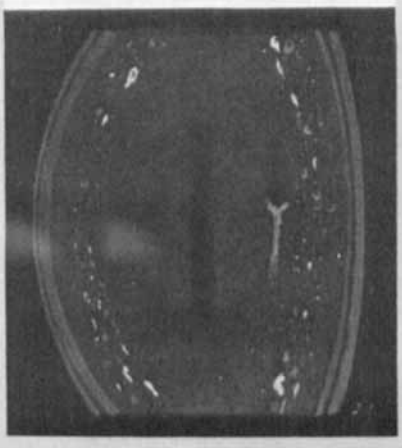

FIG. 17c.

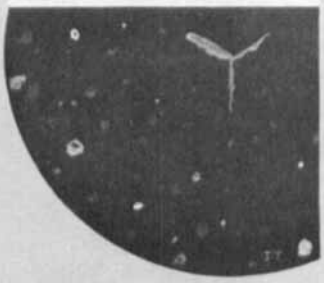

FIG. 17b.

FIG. 17a.

FIG. 17. Lens of mongoloid No. 32, aged 26 years. (*a*) Appearance with loupe showing Y sutural cataract and peripheral splashes. (*b*) Magnified view of Y suture cataract and flakes. (*c*) Optical section showing Y suture cataract in the deepest layers of the foetal nucleus, with flakes of different colour and size localised to the infantile and adult nuclei.

FIG. 18a.

FIG. 18b.

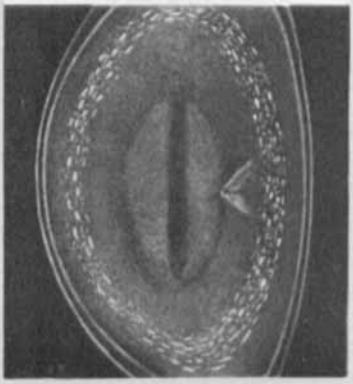

FIG. 18c.

FIG. 18. Lens of mongoloid No. 48 aged 37 years. (*a*) Appearance with loupe showing numerous small blue flakes, especially towards the periphery. (*b*) Optical section without magnification showing flakes in distinct bands in the infantile and adult nuclei. (*c*) Optical section with slit-lamp microscope showing different sized flakes thickly spread in the infantile and adult nuclei. The Y suture opacity is only seen with high magnification.

FIGURE 4

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FIG. 19*a*.

FIG. 19*d*.

FIG. 19*b*.

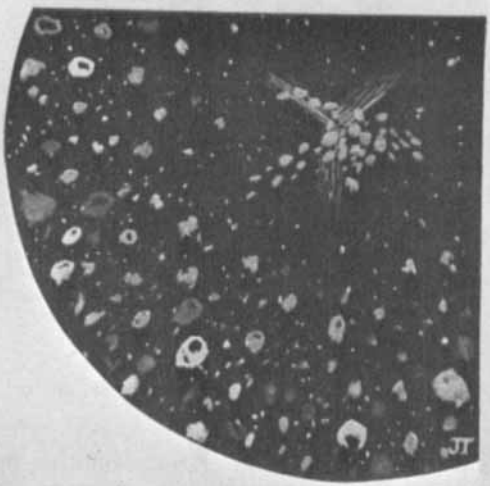

FIG. 19*c*.

FIG. 19*e*.

FIG. 19. Lens of mongoloid No. 41, aged 32 years. (*a*) Appearance with loupe showing small flakes and posterior polar cataract (*b*) Optical section without magnification showing flakes within the adult and infantile nuclei, fine opacities in the foetal Y suture and posterior polar cataract. (*c*) Magnified view of feathery Y suture cataract extending in depth throughout the foetal nucleus. (*d*) Denser opacities in the less regular sutures of the infantile and adult nuclei. (*e*) Magnified appearance of flakes showing different colours and bizarre forms, thickest towards the periphery.

FIGURE 5

(Reproduction courtesy of the British Journal of Ophthalmology.)

include nuclear, zonular, anterior and posterior polar as well as disciform varieties. These constitute less than 68% of the total cataracts.

Acquired lens opacities are usually arranged in zonular distribution like the growth rings of a tree and include polychromatic crystals, cerulean flakes or rings, dense or thin "snowflakes" and coronal opacities.

In passing, it is of interest to note that while most cataractous changes in Down's syndrome are progressive, it is very seldom that they become dense enough to warrant surgical interference.

Keratoconus and Corneal Opacities

Keratoconus is characterized by a conical or increased curvature of the inferior-temporal central portion of the cornea (FIGURE 6). It is usually quite

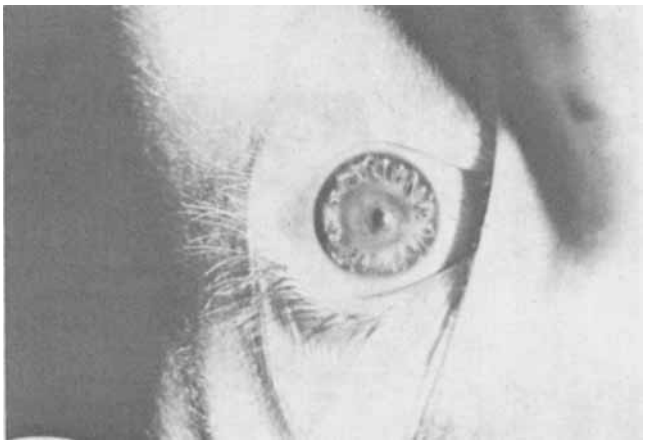

FIGURE 6

thin at the apical region. Keratoconus has been reported in Down's syndrome in 1–8% of the cases, usually appearing after puberty; perhaps it reflects a disorder of connective tissue and superimposed constant rubbing trauma by the patient. Acute keratoconus and/or acute hydrops of the cornea occur(s) more frequently in Down's syndrome than in any other known disorder. Such acute onset may support the aforementioned contention that the increased incidence in Down's syndrome may be due to a combination of internal and external causes. It should be watched for in mongolism, since prompt therapy is paramount to the prevention of blinding complications.

Corneal opacities may be congenital or acquired. When congenital, they are usually associated with a developmental anomaly of the anterior chamber and angle. Such anomalies are very rare in mongolism. Acquired corneal opacities are usually secondary to traumatic or infectious keratitis. These are quite common if cases of Down's syndrome are subjected to careful biomicroscopic examination.

Iris Stroma and Iris Color Aberrations

Brushfield's [5] spots are well known and constitute a fairly common sign in mongolism (85–90%). These white, gray, or yellowish-brown spots (FIGURE 6) are small, round or oval denser aggregations of the iris stroma. They are usually situated near the junction of the middle and outer one-third of the iris surface, and are more numerous and conspicuous than they are in the normal individual (24%); [6] they are present in darked pigmented irises, contrary to reports in the literature. Magnification must be employed to find them in pigmented irises, whereas they are conspicuous to direct observation in blue or hazel irises.

There is a relative paucity of the mesodermal stromal leaf of the iris in Down's syndrome. The easy visibility of the iris sphincter, large crypts and visible thinness of the peripheral iris attest to this finding. The peripheral zone of the stromal thinness permits easy observation of the underlying neuroectodermal pigmented leaf of the iris.

In a few cases of Down's syndrome that were subjected to anterior chamber gonioscopy, iris processes have been noted. Further study of this angle is indicated in mongolism.

The literature suggests that a high incidence of blue or light hazel irises exists in Down's syndrome. It is the opinion of this author that this iris color is dependent on the ethnic background of the patients and that any normal control in the same geographic locality would indicate nearly similar incidence.

Errors of Refraction

Myopia, particularly of high degree (6–10 diopters), is seen in about 30–35% [4] of the cases. Myopic macular and circumpapillary retinal degenerative changes seem to occur rather early in life in Down's syndrome and perhaps explain the rather poor level of corrected visual acuity encountered so frequently. Furthermore, this myopia appears to be congenital and is associated with nystagmus; the latter may disappear within a few years after birth.

Muscle Imbalance

Overt muscle imbalance, strabismus (FIGURE 7) is commonly encountered in most syndromes having associated mental retardation. In this respect, Down's syndrome is no exception. The incidence of strabismus, usually esotropia-convergent, has been variably reported in from 12–23% of the cases studied.

Configuration Changes of the Eyelids and Palpebral Fissures

The anomaly of the direction or slant, the size and shape of the palpebral fissures ("mongoloid slant") is perhaps the best known of the Down's syndrome signs. The up-and-out slanting palpebral fissure occurrence, however, is not ubiquitous (75–88%); [2, 10] it may be absent, unilateral, or the individual may present an antimongoloid slant.

However, the most characteristic of the Down's syndrome palpebral aperture is the even arch of the upper eyelid margin, with its highest arch occurring

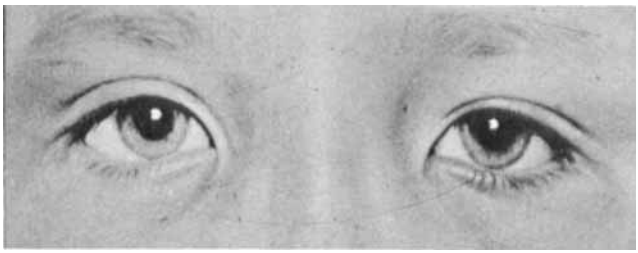

FIGURE 7

in the center of the lid (FIGURE 8). This is contrary to the normal eyelid in that the high point of the arch is at the junction of the inner and middle third.

The epicanthus is a semilunar fold of skin which extends downward from the upper eyelid along the nose, usually covers the inner canthus, and is concave toward the latter. This winglike structure is a very common disorder (30%) in Caucasians during the first three years of life and is normal during the third to the sixth fetal months. In most Caucasians, this fold disappears with the eventual development of the nasal bridge, usually at puberty. It persists beyond this age in about 2–5% of normal individuals, and may exhibit a dominant mode of hereditary transmission.

The epicanthus is reported to occur in about 28% of cases of Down's syndrome. My experience would suggest that this figure is too high, particularly in adult mongoloids. Perhaps the flat nasal bridge is frequently misinterpreted to represent the epicanthus.

The palpebral fissure in a Down's syndrome subject is 3–5 mm shorter than in the normal individual, at least as measured by interpupillary and external to external canthal distances.

Ocular Infections

The Down's syndrome patient presents in institutions with chronic nasal discharge, chronic conjunctivitis, and blepharitis marginalis. The adenoviruses, so ubiquitous in institutional life, seem to account for the rhinitis and conjunc-

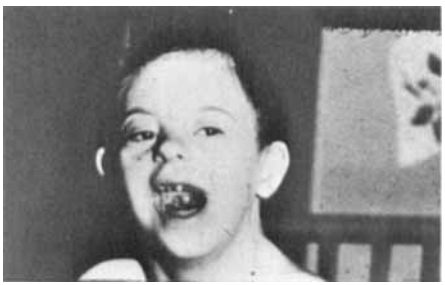

FIGURE 8

tivitis. The blepharitis is usually due to staphylococcus aureus and/or seborrhea. Noninsitutionalized children are much less frequently affected. As was previously noted, corneal infection must be carefully watched for in such cases and promptly treated to avoid corneal scarring.

Radiological Anomalies of the Orbit

Since the author has had very little personal experience with this aspect of Down's syndrome, the most meticulous and well-controlled study by Erik Kisling [7] in 1966 will be quoted freely. This study was a comparative roentgencephalometric report of 71 adult males with Down's syndrome aged 19–25 years. The control group consisted of 102 male dental students aged 20–29 years. In general, Kisling's findings indicated "that in Down's syndrome there is a generalized inhibition of growth rather than restricted growth in specific growth zones." [1]

In comparison with the normal, Kisling's cases of Down's syndrome presented the following: (1) the orbits were shorter, the difference being smallest in the cranial part of the orbit. The height of the orbits was the same as in the normal controls. (2) The orbital openings were directed more downward and backward; (3) the orbits were situated further cranially; (4) the nasal bone was shorter and less proclined; aplasia of the nasal bone was found in 9 out of the 68 cases of Down's syndrome, and (5) the height of the anterior cranial fossa was greater in the central parts, whereas it was lower in the lateral parts. No attempt was made by Kisling to explain the mongoloid slant of the palpebral fissures from his orbital x-ray findings.

Øster and other authors found frequent (71%) absence of the orbital ridges and, in addition, the frontal sinus was absent bilaterally in 50% of Down's syndrome cases.

Miscellaneous Findings

Berg [7] and his associates investigated a clinical observation which suggested that Down's syndrome patients seemed to manifest an exaggerated response to the drug atropine. These investigators found that mongoloids exhibited a more rapid and sustained pupillary dilation to a topical drop of atropine in comparison to the normal controls. However, these authors failed to mention the degree of pigmentation of the irises of either the Down's cases or the controls. It is well known that blue irises respond to atropine in the manner described in this paper.

Summary

The ocular manifestations of Down's syndrome have been subdivided into nine categories. Emphasis has been placed upon the important contribution of the ocular manifestations toward establishing the diagnosis of Down's syndrome.

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